Standard of Materials Specifications, their Implementation and Enforcement on Building Construction Projects in Nigeria

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Abstract

Specifications, as drivers of good standard of construction, are suffused with a lot of challenges in Nigeria. The main aim of the study was to assess the quality of materials specifications in Nigeria and their effect on standard of Nigerian construction. The objectives of the study were to examine the contents of specification clauses and to appraise their implementation and enforcement. Three surveys were carried out including, survey of specification documents to generate data on the content and quality of specification clauses, questionnaire survey of specification writers and users to generate data on specifications writing and implementation and market survey to obtain data on the availability of specified materials in the market. The surveys carried out during the study revealed that many important specifications details are frequently left out, there are no regular market surveys to ascertain the availability of the materials specified, the legal framework for the enforcement of specifications is weak, poor quality specifications and their inadequate enforcement give rise to frequent cases of rework and dissatisfaction of clients. All these undermine the standard of building construction in Nigeria.

Keywords: construction specifications, Nigeria, standard of construction

Introduction

The construction industry in Nigeria is fraught with problems which impair the standard of construction and which, according to Adenike (2006), Grema (2006) and Bamisile (2004), are often hinged on quality of materials and workmanship and can be controlled by proper use of contract specifications. Unfortunately, specification standards and building regulations as drivers of good standard of construction are suffused with a lot of challenges.

In Nigeria, there are few existing national standards relating to building construction, many of which are not known (Bamisile, 2004). As a result, the designers use mainly British and American Standards and Codes despite the fact that local requirements are often different. Serpell et al. (2002) observed that the development process of standards is difficult, cumbersome and unstable. This aggravates the situation with respect to specifications. In Nigeria, specifications which are supposed to collate all relevant standards for incorporation in the contract and, which constitute the key document for quality management are frequently absent (Bamisile, 2004). Also, according to Bamisile (2004), the designers in Nigeria do not often detail their working drawings but leave the specifications to be written by quantity surveyors. This is probably because many designers in Nigeria lack adequate knowledge with respect to the function and performance of the materials and components they specify (Adafin et al., 2011, Folorunsho & Ahmad, 2013).

The results of the survey carried out by Lam et al. (2004) showed that lack of co-ordination, ambiguities, irrelevant clauses, inappropriate standards and reluctance of designers to embrace quality culture are the frequent problems in drafting of specifications. Specifications are often not complied with in quality control of materials and works on site (Sani & Othman, 2011).

Gelder (2007) categorized the specification problems in practice into two broad groups - unsound specifications and unused specifications. Unsound specifications arise because specifications are often not well written. Unused specifications refer to problems that arise when specified products/services are not used. The causes of unsound specifications, according to Gelder (2007) are misuse or misquoting of standards, non-compliance with regulations, pseudo-specifications (more content than needed and not job specific) and conflict with drawings. Unsound specifications are those that are unused by contractors (40% of UK contractors 'broke' specifications) and by contract administrators or building enforcement officers.

There are useful yardsticks to measure the quality of specifications, some of which Lam et al. (2004) and Gelder (2007) referred to as:

- Consistency in all the contract documents
- Existence of clauses irrelevant to the project at hand
- Ambiguous meaning requiring clarification
- Too wordy and complicated sentence structures
- Format which may render it difficult to find relevant information
- Outdated standards being specified
- Standards being specified not available locally
- No equivalent material available locally
- Incomplete information for construction purpose

- Misquoting of standards
- Rework due to inconsistency or ambiguity of specifications
- Cost adjustment in terms of cost and time due to alternative material approved
- Rejection of work due to non-adherence to specifications
- Client's satisfaction

On the whole, Serpell et al. (2002) and Jefferies et al. (2003) maintain that improvements in standard of construction is possible through coordinated and committed participation of all stakeholders in the industry using specifications as the key document for quality management.

The main aim of this study was to assess the quality of materials specifications in Nigeria and their effect on standard of Nigerian construction. The objectives of the study were to examine the contents of specification clauses and to appraise their implementation and enforcement.

Methodology

Three surveys were carried out including, survey of specification documents to generate data on the content and quality of specification clauses, questionnaire survey of specification writers and users to generate data on specifications writing and implementation, and market survey to obtain data on the availability of specified materials in the market.

A framework for the study of specification documents was developed in the form of a check-list and in line with the criteria for assessing the quality of specifications in contract documents. Specification documents (architectural, structural and services drawings and the bills of quantities) for thirty construction projects were studied. Snowball sampling method was used as a sampling technique because many professionals are not willing to release documents which contain vital details of contract.

Questionnaire survey employed the use of well-structured questionnaire. A total of three hundred and thirty (330) questionnaires were distributed, made up of:

- Sixty (60) questionnaires in each of the three regions of South-East, South-West and North; twelve (12) to each of the five population units of architects, structural engineers, services engineers, quantity surveyors and users of specifications.
- One hundred and fifty (150) questionnaires distributed equally among the same groups of practitioners in the Federal Capital Territory (FCT).

Snowball sampling was used for questionnaire survey as there was no reliable data on practicing professionals and users of specifications to use as sampling frame. Two hundred and forty (240) questionnaires (representing 73%) were properly completed and returned.

Market survey of commonly specified building materials was undertaken to ascertain their availability.

Expert sampling was carried out in the form of an interview to obtain information on government actions as regards implementation and enforcement of specifications.

Data Presentation and Analysis

Some selected characteristics of respondents

Table 1 and Figure1 reflect some selected characteristics of respondents with respect to their occupation and areas of their operations.

Table 1: *Distribution of Respondents by occupation*

Area of operation	Architect	Structural Engineers	Services Engineers	Quantity surveyors	Users	Total	Percent
South-East	8	8	8	8	8	40	16.67
South-West	8	8	8	8	8	40	16.67
North	8	8	8	8	8	40	16.67
FCT	24	24	24	24	24	120	50.00
Total	48	48	48	48	48	240	100.00

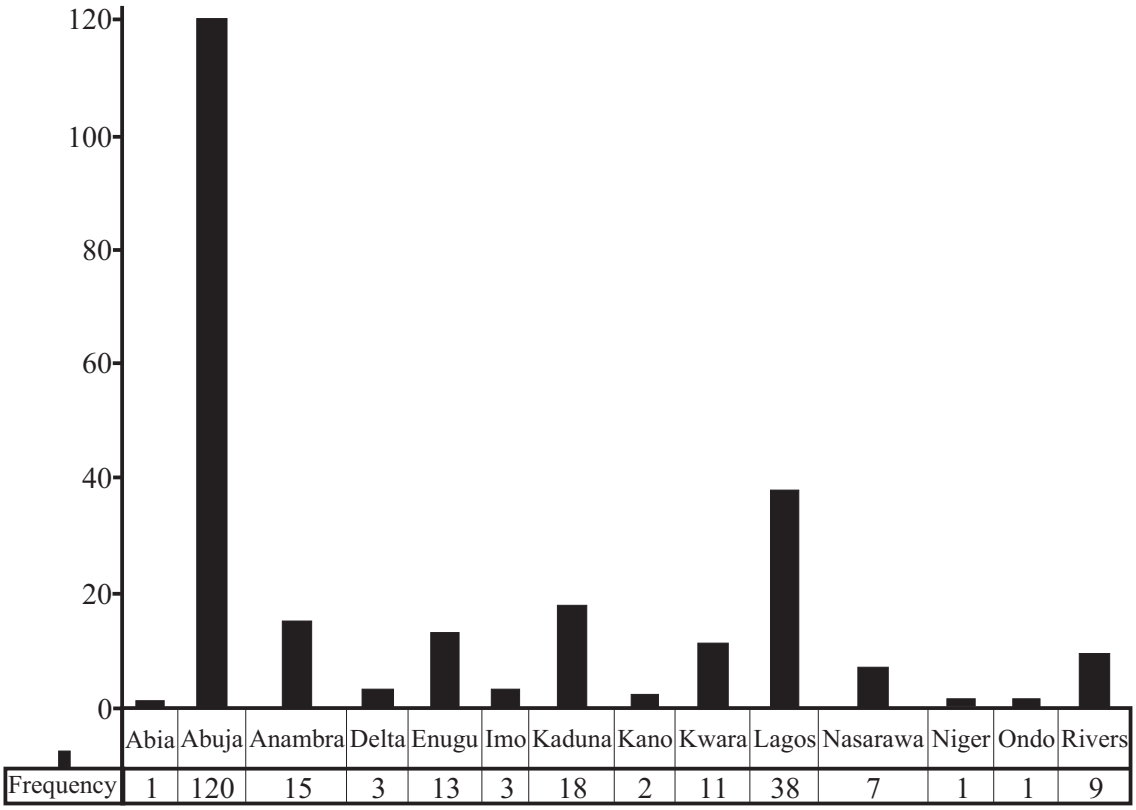

Figure 1: *Distribution of Respondents by Area of Operation*

Examination of specifications clauses content

The study of the content or quality of specification clauses included clarity of specification clauses, existence of clauses/details irrelevant to the project, consistency in specification documents, incomplete information for construction purpose, availability of specified materials locally, use of appropriate codes or standards in specifying materials.

The analysis of the content of specification clauses revealed that many of the drawings studied did not contain adequate written details (Table 2). In both the drawings and Bills of Quantities (BOQ), unclear/ambiguous on",

expressions were observed, such as: “hardcore flush door”, “architraving”, “rock laterite filling”, “compact to building 100% BS compaction”, “mortar 1:3 in concrete”, “other equal and approved”, “suspended ceiling on hardwood noggins” and “iron mongery custom-made door”. Such ambiguous expressions were observed in about 33.33%, 1.33% and 6.67% of architectural, structural and services drawings respectively.

Table 2: *Quality of specification clauses on drawings (%)*

	Types of drawing		
	Architect	**Structural**	**Services**
Details of specified materials	6.67	13.33	0.00
Ambiguities	33.33	13.33	6.67
Inconsistencies	13.33	13.33	6.67
Incomplete information (number of occurrences)			
0-5 (low)	6.67	46.67	6.67
6-10 (moderate)	20.00	13.33	86.67
Above 10 (high)	73.33	40.00	6.67

Clauses irrelevant to the project abound in electrical and plumbing/mechanical drawings, in form of 'legend'. 'Legend' is a table containing symbols used in the drawings, the items they stand for and a brief description of items (specifications). It was observed that many engineers develop a 'master legend' containing common items or materials represented by symbols and repeat such 'legend' for all drawings that emanate from their offices. Unfortunately, many of these items are frequently irrelevant to a particular project. It has been observed that 66.67% of services drawings studied contained such a 'legend' (Table 3). As a result, users often do not bother to study them and it complicates finding relevant information.

There was high rate (83.33%) of occurrence of unedited preamble clauses of the Bills of Quantities (BOQ). Also, significant number of preamble clauses (40%) contained irrelevant sections (Table 3). For example, they contained sections on even 'demolition', for new projects on virgin plots of land.

Table 3: *Observations peculiar to services drawings and BOQ on quality of specification*

	Observations	**(%)**
Services Drawings	Legend exists in services drawings	66.67
	Irrelevancies in legend	40.00
BOQ	Unedited preambles	83.33
	Inconsistencies between BOQ and drawings	58.33

Consistency of specification details was checked within the drawings and between the drawings and bill of quantities. The inconsistencies within the drawings constituted 13.33%, 13.33% and 6.67% of architectural, structural and services drawings,

respectively (Table 2). However, the rate of inconsistencies between the bill of quantities and the drawings was considerably higher (58.33%) (Table 3) and included concrete strength, concrete mix and thickness of aluminium roofing sheets. Also, 73.33%, 40.00% and 6.67% of architectural, structural and services drawings, respectively, had significant content of incomplete information for construction purpose (Table 2) especially with respect to quality of construction materials. Some of the areas that lack sufficient detail for construction purpose include:

Architectural drawings - exact type or model of iron-mongery; details of roofing sheet accessories in terms of sizes and shapes; sizes and shapes of door frames; details of aluminium window sections; type or properties of tiles, ceiling sheets, skirting, architraves and cornices; types, brands and grades of paints required

Services drawings - proper description of grades of pipes and accessories; type or quality of distribution boards and MV panels; details of fire fighting materials; types or model of switches/sockets; electrical fittings; description of sanitary wares

Structural drawings - strength requirements for sandcrete blocks; details of timber roof structure; and bar bending schedules

It was further observed that when necessary details are not provided by the designers; quantity surveyors take the initiative of providing these details in the bills of quantities (BOQ). Sometimes the details provided by the quantity surveyors frequently do not reflect the designers' conceptualization of the project, which leads to conflict.

In the bill of quantities (BOQ), quantity surveyors frequently use provisional sums to cover aspects of the works that lack sufficient details. This is in conflict with the intended use of provisional sums as they are designed to cover unforeseen works or works whose exact nature could not be known at the time of contract documentation. Provisional sums are not supposed to be used as substitutes for quality specifications. It was observed that provisional sums were also used to cover some aspects of the works which had sufficient details; this could be blamed on insufficient time for proper measurement and billing. Common cases of wrong use of provisional sums observed are in staircase balustrade, electrical installations, plumbing/mechanical installations and drainage/external works.

Availability of Specified Materials

The analysis of responses from quantity surveyors revealed that many of the specified materials are not really available. 72% of the users of specification also indicated that frequently specified materials are not available in the market. The market survey identified two main problems with respect to specification of materials:

i) Unavailability of specified materials - cases of unavailability of specified materials were observed commonly in electrical and plumbing fittings and some specialized builder's materials like 'dieldrex' anti-termite solution.

ii) Identification of specified materials - this problem is created by the use of catalogue code numbers or British reference codes, which are not used by vendors and suppliers. This creates opportunities for adulteration of materials, which is common. The following exemplifies the above

Observations.

Cement: Ordinary Portland cement is packaged in 50kg bags. Samples of some bags were weighed and weights varying from 35kg to 45kg were detected in 53% of the shops surveyed.

230mm hollow sandcrete blocks: Different heights and web thicknesses were observed in products from different manufacturers resulting to blocks of varying weights from 18 - 25kg.

Cylinder mortise lockset: Various brand names exist in the market at divergent prices and different qualities. Different brands are available from China, Italy and Romania. 300 x *300mm unglazed ceramic floor tiles:* There are many varying grades and varieties from Italy, Brazil, China, United Arab Emirate and Spain, and these co-exist with many local alternatives from Royal Ceramics Ltd and Porcelain ware Industries Ltd.

All above would justify the call for more detailed information, that must accompany materials specified.

Implementation and enforcement of specifications

Legal framework

The National Building Code (NBC) is designed to be the master source from which specification writers could extract information. The Code stipulates the required standards for the design and construction. Many construction professionals however regard NBC as inadequate for various reasons (Figure 2).

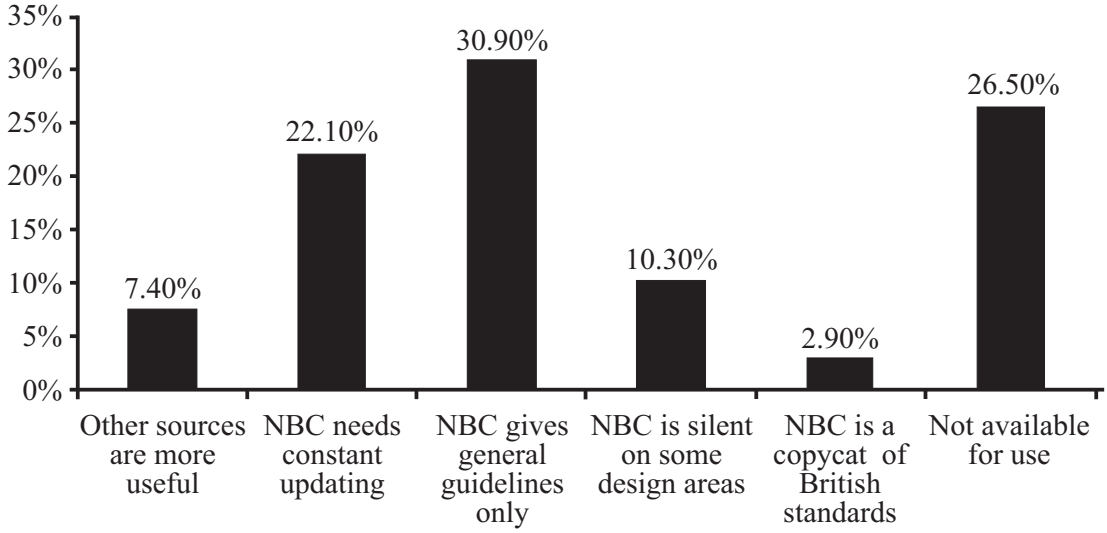

Figure 2: *Reasons for non-utilization of National Building Code for specifications*

After ensuring that the correct materials have been specified, it is necessary to ensure that they are actually utilized for the works. Responses from users of specification reveal that they indulged in use of unspecified materials for building construction in some occasions. These occasions include when specified materials were not adequately described, or too expensive, or when they were not available in the market. When unspecified

(inferior) materials are detected, the designers are expected to give instructions asking the contractor to remove such materials from site.

When the designers detect that inferior materials have been used for the works, they are expected to issue an instruction to the contractor asking him to pull down and remove from site all works affected by the use of the inferior materials. When such instruction is not adhered to, the architect could withhold payment as the conditions of contract usually empowers the architect not to pay for unsatisfactory works.

The questionnaire survey addressed the actions taken by designers when contractors use inferior unspecified materials (Table 4). The result of the analysis indicates that 48.35% of architects, 47.73% of structural engineers and 45.12% of services engineers order rework. The results also reveal that 19.78% 15.91% and 19.51% of architects, structural engineers and services engineers, respectively, do not pay for the affected works in subsequent certificate.

Table 4: *Actions taken by designers when inferior/unspecified materials are used (%)*

Actions	Architects	Structural Engineers	Services Engineers
Order rework	48.35	47.73	45.12
Refuse to pay for affected work	19.78	15.91	19.51
Notify the client	15.39	20.45	18.29
Warn the contractor	16.48	15.91	17.07
No action	0	0	0

This study addressed the methods of checking the quality of materials delivered to construction site (Figure 3). Inspection is the most commonly used method by designers (65%) to check quality of materials delivered to site in a building project. Inspection, however, is often not adequate for ensuring standards.

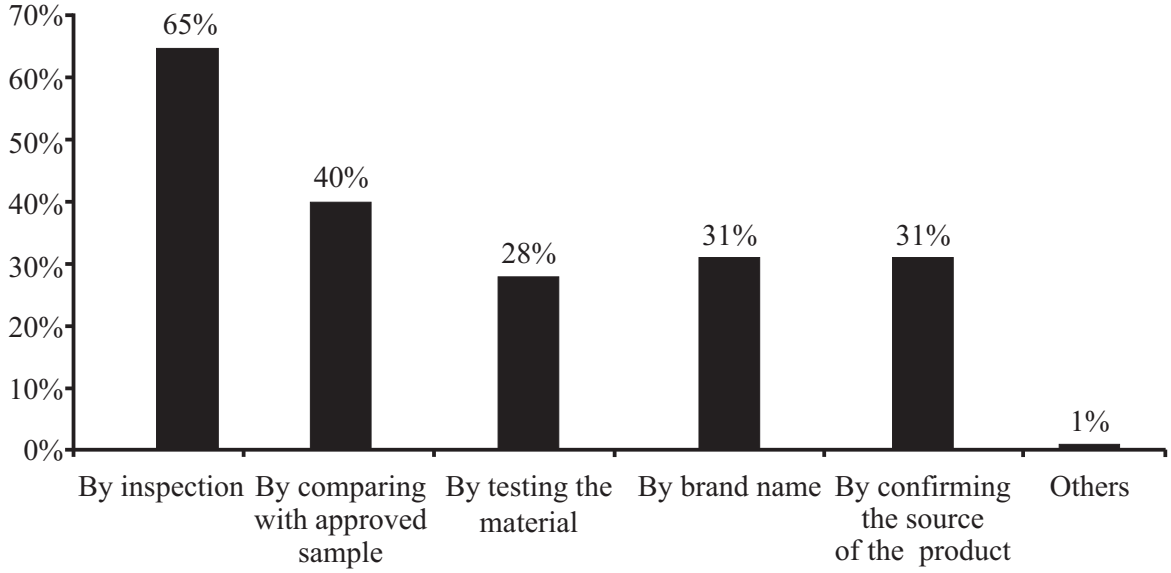

Figure 3: *Methods of conformation of products brands*

Enforcement of Specifications by Relevant Government Agencies

The questionnaire survey addressed the enforcement of specifications during the construction stage of the projects. The users of specifications were asked to indicate the stages of the building construction project that are checked by inspectors. The results of this part of the survey are reflected in Figure 4 and indicate that most of the inspection occur at the setting out stage (54%) and sometimes there is none (14%).

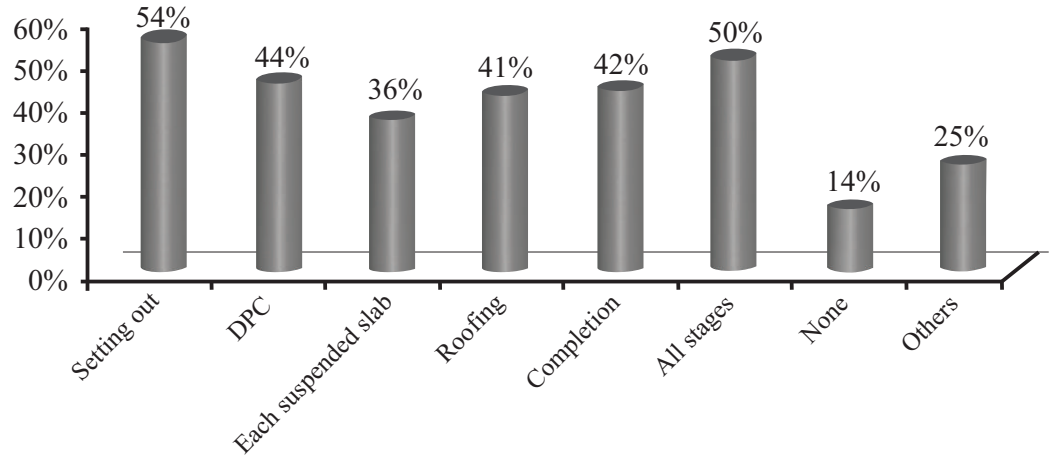

Figure 4: Stages of Building Construction Inspected by Building Regulator

The interview of the Director of Abuja Metropolitan Management Agency (AMMA), used in the study as expert sampling, revealed that Building Regulations and Control Departments monitor building construction. A certificate of Fitness for Human Habitation is issued to the developer upon a satisfactory completion of construction project. The National Building Code allows for the establishment of Code Enforcement Unit/Division with powers to ensure effective enforcement of the stipulated standards. Unfortunately, it is not yet active even where it exists. The regular courts could adjudicate over cases of construction standards enforcement, but the department is not usually inclined to suing offenders. Poor staffing of the Building Regulations and Control Department was given as one of the main reasons for the above. When specifications are not complied with, building inspectors serve the relevant written notice, depending on the severity of the offence, if verbal warning is ignored Three notices exist, such as; stop-work, quit and demolition. Besides, approval to continue further works is withheld until necessary corrections are effected. Notwithstanding the high occurrence of stop-work notices in the construction field however, construction works still continue without effecting ordered corrections. The interview revealed that the Department usually follows the rule of law and as such the actions leading to pulling down parts of structures are usually delayed and eventually are not carried out. Demolition is carried out only in extreme cases when collapse or danger is imminent. When construction work is executed without approval, the usual procedure adopted is to issue stop-work order and then order for a Schmidt Hammer test on

the structure. The structure is pulled down if it is found to be unsatisfactory; otherwise, a contravention fee is paid and the building is given "as-built approval".

Notwithstanding the existence of the policy guidelines for effective implementation of specifications, the interview revealed that the level of implementation is low as control of quality of material is poor due to non-availability of a standard laboratory to carry out necessary tests to confirm quality of materials being used. Also, the department is grossly under-staffed. This makes it very difficult for the department to monitor works in both the cities and hinterland and for all stages of construction.

Effects of Specifications on the Standard of Building Construction

The criteria for assessing the effects of specification on the standard of building construction considered in this work included rework, client's satisfaction and cost adjustment due to use of approved alternatives to specified materials. According to survey (Table4), 48.35%, 47.73% and 45.12% of architects, structural engineers and services engineers, accordingly, order rework; while 19.78%, 15.91% and 19.51% of the same categories of respondents refuse to pay for the works. In both cases, rework is inevitable.

When rework is ordered, particularly when it involves works on the critical path, it causes delay to the progress of the works. The time it takes to pull down the affected works and the time to re-construct in accordance with specifications constitute the total delay to the contract period. The effect of this delay is borne by the client or the contractor depending on the contract conditions. Even when the work is not on the critical path, in which case the contract duration is not affected, the time taken to effect such amendments by the operatives still constitutes loss of construction time.

Apart from loss of time, rework costs money. The monetary cost of the abortive work in terms of materials and workmanship in addition to the cost of pulling it down constitutes loss of profit to the contractor and monetary loss to the construction industry as a whole. Sometimes, rework involves pulling down a structural member of the building. The impact of such removal at times affects adversely some adjoining members of the building fabric. In such situations, it is unlikely that clients' satisfaction was fully achieved.

The study also revealed that while some of such changes were not approved by the designers, others were duly approved. The reasons include: unavailability of specified materials, discrepancy in specification details in contract documents and non-clarity of specification clauses. Provisional sums are used to deal with such situations after the approval by the designer.

When an alternative to the specified materials is used by the contractor without approval, the contractor either bears the entire cost of remedial works or the net extra cost, if the alternative material is inferior and hence rejected, or the alternative is of higher quality than the specified and is hence accepted by the designer.

Conclusion and Recommendations

Based on the analyses carried out, the following major findings were made:

- Specifications are often presented on working drawings without complementary notes or instructions thereby causing many important

specification details to be left out. Cases of ambiguous expressions exist in specifications in practice; and many drawings lack sufficient details necessary for construction purposes.

- There are no regular market surveys to ascertain the availability of the specified materials for building projects. This results to unavailability of some specified materials in the market.
- Quality assurance of materials supplied for building construction is poor as the method of checking of materials by designers is by visual inspection. The use of instruments or laboratory tests is not common.
- Enforcement of specifications is poor; the Development Control Department (which is the only external monitoring team) issues stop-work order but rarely attempts to enforce it. The legal framework for the enforcement of specifications is weak. The Urban Tribunal set up as a specialized court to try building construction cases is not yet operational.
- Poor quality specifications and/or poor implementation and enforcement give rise to frequent cases of rework and dissatisfaction by clients.

All of the above undermine the standard of building construction in Nigeria. Therefore, it is recommended that:

- Specification of materials should be done early enough during the design process to give enough time for necessary checks, corrections and adjustments as the designs and costs unfold.
- Designers should undertake regular market survey at the design stage to ascertain availability of materials to be specified and to improve their knowledge base on new materials in the market.
- Adequate information should also be given for proper identification of the materials specified. The designers should check the quality of materials. Establishment of standard laboratories for this purpose is imperative.
- The Building Officers should make effective use of issuance of certificate of fitness for human habitation by effecting the sealing-off of non-complying premises. Also, the public should be enlightened on this certificate so that even prospective occupants could demand for it.

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